



Waste Industry Experts

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April 26, 2004

Mr. Jim Barber  
NC DENR - Permitting Branch  
Division of Waste Management  
Solid Waste Section  
1646 Mail Service Center  
Raleigh, NC 27699-1646

Fac/Perm/Co ID #	Date	Doc ID#
419T	7/12/2011	DIN, 4576

**RE: March 11<sup>th</sup> Meeting Summary  
Star Environmental Proposed C&D Landfill,  
Guilford County North Carolina  
JEI Project No. 673.00 Task 01**

Dear Mr. Barber,

This letter is intended to summarize the meeting held on March 11, 2004 at your offices, in which the Rankin Fryar site, located in Guilford County, was discussed as a possible site for a construction and demolition landfill (CDLF). Those in attendance were including yourself Bobby Lutfy (NCDENR), Hugh Gauntt (Riley, Park, Hayden & Assoc.), Steve Goode (Star Environmental), and myself.

The main purpose of the meeting was to discuss historical drilling and excavation operations that have occurred at the site and to describe a procedure for making the site suitable for a proposed CDLF. This site is currently an active sandrock mine, permitted under 41-19. As part of normal operations, excavations have occurred over most of the site, with some backfilling occurring as well using clean soils and inert debris. In addition to the normal excavations, Vulcan Materials did exploratory drilling of the site to determine mineral contents at greater depths. The concern expressed by local residents has been more centered on the drilling that has been conducted at the site as many of the drill holes went into lower bedrock formations.

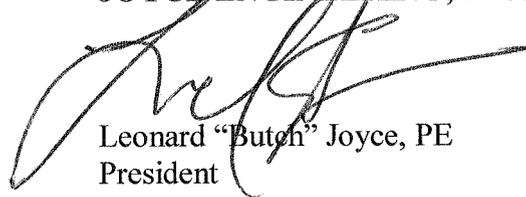
Mr. Gauntt, a professional engineer from Riley, Park, Hayden & Associates, Inc., proposed a technique using a concrete slurry mix (grout) that would essentially create a vertical curtain and fill each of the holes (to be determined by coordinate system), and any associated cracks that may have developed around the holes. Many of the holes have been excavated, but fortunately, were marked using a coordinate system. The coordinates will be used to locate the area in which a new hole will be created, and then pumped full of the concrete slurry mix to form a seal. This seal will reduce the potential for migration of water or fluids into the drinking water aquifer. Drawing No. 1 shows the location of each of the drilled holes.

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We understand that a formal proposal with a greater level of technical detail will be provided to your staff, should this project receive local government approval. We would also welcome your attendance and observation of the procedure as to assure your department that the site has been adequately protected for receiving future C&D waste. A complete construction permit application will be submitted for approval prior to any on-site construction activity occurring, excluding normal mining operations.

We hope this letter satisfactorily describes our discussion and plans for this site. As you had stated in our meeting, NCDENR will provide a written statement of position for use in the local government approval process. Please call me at (804) 357-5180, if you have any questions about this letter or its attachment.

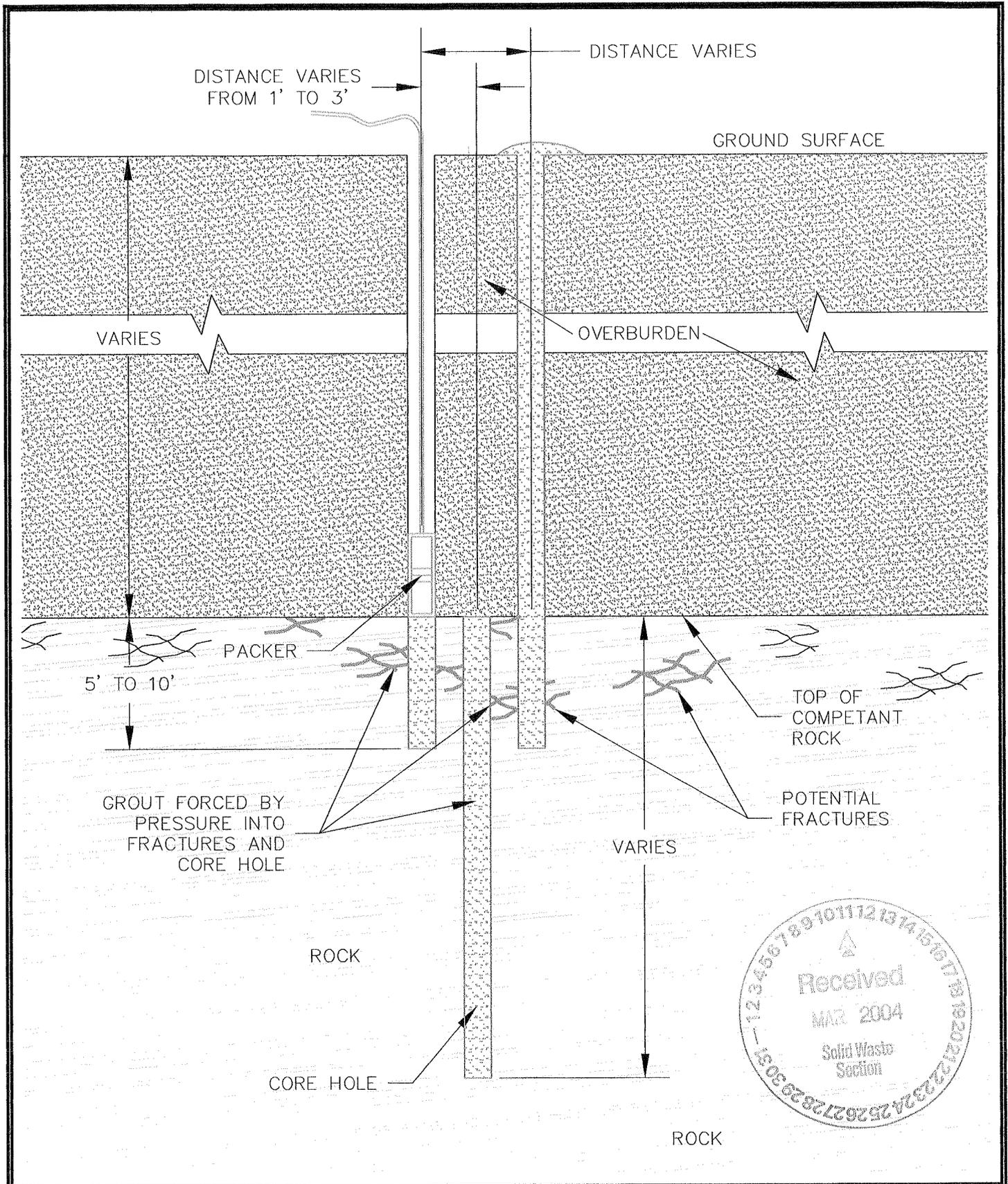
Sincerely,  
**JOYCE ENGINEERING, INC.**



Leonard "Butch" Joyce, PE  
President

Enclosure

Cc: Mr. Steve Goode – Star Environmental of NC, LLC  
Mr. Hugh Gauntt, PE – Riley, Park, Hayden & Assoc.  
Mr. Bobby Lutfy – NCDENR  
File



PROJECT OWNER  
GUILFORD, NC

**FIGURE**

DATE:	SCALE:	JOB NO: 6012
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RILEY, PARK, HAYDEN & ASSOCIATES, INC.  
ENGINEERS & SURVEYORS  
NORCROSS, GEORGIA  
770-447-0041

**RPH**

## Hydrogeologic Discussion and Groundwater Monitoring Plan

The Fryar Sandrock site is located in the Carolina Slate Belt of the Piedmont physiographic province. The site area is underlain by a felsic intrusive complex, the weathered deposits of which have been mined as sandrock. Sandrock is a regional term applied to weathered granitic rock, or grus deposits in the Piedmont. Such deposits are valued as aggregate with high compactability properties. The felsic intrusive complex of this area is generally massive, and is relatively isotropic when compared to other metamorphosed gneisses and schists of the Piedmont which can locally provide preferential groundwater flow paths due to their stratified nature. The massive nature of the felsic intrusives is an obvious attribute for designing the groundwater monitoring system for this facility.

The proposed facility is surrounded on the north and west sides by South Buffalo Creek, which flows clockwise around the facility, or in an overall northeast direction. The property line for the facility in this downgradient area follows the approximate centerline of the creek. This is significant from a hydrogeologic standpoint; Fryar Sandrock owns the property to the groundwater discharge point, South Buffalo Creek. It is unlikely that groundwater flow from the site crosses this groundwater flow divide. Groundwater flow in the site area is in a general north direction, from the topographic high of McLeansville Road near the south side of the property into the site area, ending in semi-radial flow toward South Buffalo Creek.

Four temporary piezometers were installed on September 8, 2000 to monitor groundwater elevations at the site. A Linkbelt 5800 track excavator was used to install the piezometers, which range from approximately 9 to 16 feet in depth. The boring logs for these piezometers are attached as Appendix ? to this report. Water level measurements were taken from all four piezometers and two existing monitoring wells on September 15, 2000 (Table ?). The groundwater contours shown in Drawing No. ? were then interpreted based on these data.



Given the groundwater flow regime described above, the site will be relatively easy to monitor for water quality. The proposed monitoring wells for the site are shown on Drawing No. X. Well MW-1 will be placed on the topographic high on the south side of the site to serve as the background monitoring point for the facility. Wells MW-2, -3, -4 and -5 will be located in the approximate locations shown, to monitor the radial flow of groundwater away from the facility. In addition to the above wells, two surface water monitoring points are proposed for the compliance monitoring program. Point SW-1 will be located at the upstream property line and point SW-2 will be located at the point South Buffalo Creek "exits" the facility. The former point serving as a check on background surface water quality entering the site, and the latter serving to detect any potential discharges of C&D constituents to the surface water.

All compliance monitoring wells for the site will be constructed and sampled in accordance with the *North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities* (DENR, 1995). This document provides the general construction specifications and schematics for waste disposal facility monitoring wells. The following table provides the proposed screen interval and approximate total depth for the wells discussed above.

Well Designation	Approximate Surface Elev.	Approximate Water Table Elev.	Approximate Total Depth*	Approximate Screen Interval
MW-1	727	695	685 [42]	700 - 685
MW-2	707	683	673 [34]	688 - 673
MW-3	689	682	672 [17]	687 - 672
MW-4	688	678	668 [20]	683 - 668
MW-5	710	684	674 [36]	689 - 674

\* Values in brackets are depths below ground surface; all others are in feet above mean sea level.

This proposed monitoring program, including location of sample points, and depth of wells is subject to approval of the Solid Waste Section during their review process.

**Fryar Sandrock  
Groundwater Elevations  
September 15, 2000**

<b>Location</b>	<b>Top of Casing Elevation (feet)</b>	<b>Depth to Water (feet)</b>	<b>Groundwater Elevation (feet)</b>
PZ-1	695.74	10.61	685.13
PZ-2	692.98	3.54	689.44
PZ-3	694.65	10.25	684.40
PZ-4	695.53	6.67	688.86
MW-1 (GW-1)	697.00	19.40	677.60
MW-1 (GW-2)	693.00	14.40	678.60

**Notes:**

1. Water levels were measured to the nearest hundredth of a foot.
2. Water levels are measured from top of casing (TOC).
3. Groundwater elevations are referenced to mean sea level.
4. TOC for MW-1 (GW-1) and MW-1 (GW-2) are approximate. Therefore, the groundwater elevations are also approximate.

# TECHNICAL SPECIFICATION

## DIVISION 02260 - DRILLING AND PRESSURE GROUTING

### 1.0 SCOPE OF WORK

The Work to be performed under this Division of the Specifications shall include:

- 1) Drilling of grout holes and exploratory holes, water pressure testing, and injection of grout under pressure for curtain grouting in the rock underlying the dam in areas where there is a possibility of significant leakage; and
- 2) Cleanup of grout debris, spillage and leakage.

Work consists of supplying all labor, material and construction equipment for core drilling four exploratory holes and drilling grout holes, washing, casing holes, water pressure testing and mixing, and injecting various grout mixtures into these grout holes and backfilling ungrouted boreholes and piezometers within the reservoir pool with a 1:1 grout mix with the packer set at the top of rock.

### 2.0 DEFINITIONS

For purposes of this Specification, the following definitions shall apply:

**Zone:** Zone means a predetermined depth of a grout curtain.

**Stage:** Stage means a partial or complete depth of hole in which grouting is performed.

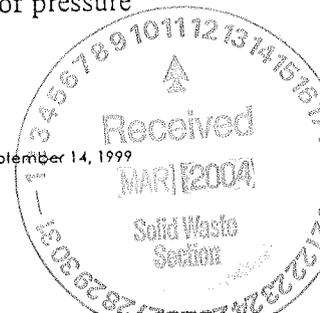
**Down-Stage Grouting:** Down-stage grouting means a procedure which consists of drilling a hole to a limited depth within a zone, grouting to that depth, and cleaning the hole by washing or other suitable means just after grout surrounding the hole has reached initial set. Hole is drilled to another limited depth and grouted, and continued in as many stages of drilling and grouting as may be necessary to secure a satisfactory job of grouting within any zone.

**Up-Stage Grouting:** Up-stage grouting means a procedure which consists of drilling a hole to its full depth, or to the base of a zone or stage, in one continuous operation, and subsequent washing and grouting of the hole in sections from bottom upwards by means of a packer assembly which is set at progressively shallower depths.

**Split-Spacing Method:** Split-spacing means a procedure of progressively closing a grout curtain by means of drilling and grouting additional holes midway between holes which have been previously drilled and grouted. The spacing of initial holes drilled and grouted may vary considerably from section to section depending upon conditions encountered.

**Curtain Grouting:** Curtain grouting means a line of holes drilled and grouted to any specified depth and direction to produce an impervious diaphragm.

**Successful Connection:** Successful connection means all operations necessary to achieve proper seating of a packer assembly that can sustain required pressure without leaking or loss of pressure during grouting to refusal.



# TECHNICAL SPECIFICATION

## DIVISION 02260 - DRILLING AND PRESSURE GROUTING

**Grout Hole:** Grout hole means a hole drilled and subsequently grouted.

**Refusal:** Refusal means the point at which grouting of any single stage is considered to be complete. This is when the grout take in a ten (10) feet stage is less than three (3) gallons in ten (10) minutes at the final grout mix (neat cement grout with a water-cement ratio of 4:1 by apparent volume) and at the maximum pressure specified for that stage.

**Exploration Hole:** Exploration hole means a core drilled hole.

Publications listed below form part of this Technical Specification to the extent specified in this Division:

### American Society for Testing and Materials (ASTM)

ASTM D 422-63 (1990)	Standard Methods for Particle-Size Analysis of Soils.
ASTM C 150-89	Standard Specification for Portland Cement.
ASTM C 404-87	Standard Specification for Aggregates for Masonry Grouts.
ASTM C 939-87	Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete.
ASTM C 109-87	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.

### American Petroleum Institute (API)

API Std. 13A	API Specifications for Oil-Well Drilling Fluid Materials.
API Std. 13B	Standard Field Procedure for Testing Drilling Fluids.

### Georgia Department of Natural Resources (GA DNR)

Environmental Protection Division, Manual for Groundwater Monitoring (Latest Edition)

## 3.0 MATERIALS

**Water:** Water used in grout mixes shall be fresh, clean and free from objectionable quantities of silt, organic matter or other impurities such as oil, acid, alkali, salts and other deleterious substances in conformance with ASTM C 150-89. The CONTRACTOR shall test the water from Bear Creek, at a laboratory approved by the ENGINEER, to determine if the source is in conformance with the referenced Specifications for water used in grout mixes. The results of such tests shall be provided to the ENGINEER prior to the use of such water for mixing grout.

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## DIVISION 02260 - DRILLING AND PRESSURE GROUTING

**Cement:** Cement shall be normal Type 1 Portland Cement complying with provisions of ASTM C150-89 and shall conform to the requirements of Section No. 3 of Division 03300. The gradation of the cement shall be such that the percent retained on the #200 and #325 meshes shall be less than approximately 2% and 5%, respectively.

**Bentonite:** Bentonite used in preparing a grout mix shall be pulverized premium grade sodium cation montmorillonite and shall meet the most current API Standard 13A "API Specifications for Oil-Well Drilling Fluid Materials".

**Admixtures:** Commercially available suspension and stabilizing admixtures and agents such as bentonite and Intraplast (Sika) shall be required. These products shall be reviewed by ENGINEER prior to their use.

**Mixes:** Proportions of materials used in grout mixture and any adjustments thereto during grouting operations shall be only as approved by ENGINEER. Proportions will be varied to suit actual conditions encountered at site. Unless otherwise specified, grout shall consist of a mixture of neat Portland cement, one (1) percent to three (3) percent by weight of bentonite and water. Flyash or fine aggregate may be specified by ENGINEER at site to be added to grout mix.

**Flyash:** Flyash, a combustion by-product of pulverized coal and ground blast-furnace slag, may be used as a filler and mixed with the slurry grout, upon approval of ENGINEER, when grout take becomes excessive. The flyash shall have a maximum particle size of 0.5 mm, retain from 15% to 25% at 45  $\mu$ , have a percentage loss on ignition of less than or equal to 5% and a moisture content of less than 10%.

**Aggregate:** Fine aggregate shall meet requirements of ASTM C 404-87 except that all material shall pass No. 16 sieve.

### 4.0 SUBMITTALS

#### 4.1 Qualifications of Grouting Specialist Contractor

All grouting shall be done by a CONTRACTOR who has extensive and recent experience in similar cement curtain grouting for dams. This Grouting Specialist CONTRACTOR shall submit evidence that the company is experienced and competent to construct an acceptable grout curtain within the foundations of the proposed dam structure. This evidence shall clearly indicate that the Grouting Specialist CONTRACTOR has previous successful experience on similar projects and has sufficient competent experienced personnel on staff to carry out the operations specified. In particular, a Grouting Specialist (as approved by the ENGINEER) shall supervise the drilling, grout slurry preparation and injection and quality control. Experience of the Grouting Specialist CONTRACTOR and the credentials of the Grouting Specialist shall be submitted to the ENGINEER at the time of bid submittal.

#### 4.2 Materials

Within 2 weeks of Notice to Proceed, the CONTRACTOR shall deliver to the ENGINEER's office in Atlanta samples of the cement, bentonite, flyash, and sand that are proposed to be used during

# TECHNICAL SPECIFICATION

## DIVISION 02260 - DRILLING AND PRESSURE GROUTING

the grouting program. These samples of materials will be used by the ENGINEER to conduct a series of laboratory tests to determine the consistency and character of various grout mixes. The CONTRACTOR shall supply a minimum of 10 x 94 lb. bags of cement, 2 x 50 lb. bags of bentonite, 100 lbs. of flyash and 2 x 50 lb. bags of sand. Manufacturer's certificates shall be supplied for all materials to be used in the grout slurry.

### 4.3 Equipment

Prior to mobilization to the site, the CONTRACTOR shall submit for information to the ENGINEER:

- A) Equipment to be used to drill the exploratory and grout holes;
- B) Equipment to be used for mixing the ingredients of the grout and pumping the slurry down the holes; and
- C) Laboratory equipment to be used for the on-site control tests.

### 4.4 Construction Records

During construction the CONTRACTOR shall submit to the ENGINEER a daily report with the following information:

- A) Work progress for drilling and grouting including number and location of holes drilled, drilling footage and quantity (both bags of cement and volume of each grout mix) of grout slurry injected;
- B) Number and indication of samples taken for control tests; and
- C) Results of control tests with identification of non-compliant results and remedial proposals.

In addition to the daily report, the CONTRACTOR shall keep permanently updated a longitudinal profile of the grout curtain, showing drilling depths and grout takes for each stage of a grout hole.

## 5.0 CONSTRUCTION REQUIREMENTS

### 5.1 Sequence

ENGINEER will map the bedrock exposed at the bottom of the core trench. Based on the mapping, the ENGINEER will identify any additional stations to be grouted. Some holes may require down-stage grouting as directed by ENGINEER.

Grout holes shall be drilled from the base of the core trench after completion of foundation treatment to the satisfaction of the ENGINEER. Usually, but not all, the holes shall be drilled to the full depth, as shown on Drawings then up-stage grouted. Some holes may require down-stage grouting as directed by ENGINEER.

# TECHNICAL SPECIFICATION

## DIVISION 02260 - DRILLING AND PRESSURE GROUTING

### 5.2 Equipment

#### A. Drilling Equipment

Drill grout holes with either rotary or rotary-percussion (including down-the-hole hammers) drilling equipment. Both vertical and inclined holes will be required. Some drill holes may need to be temporarily cased to remain open prior to and during the grouting process. Deepest holes will normally be on the order of 50 feet deep below ground surface but some holes may be up to 100 feet deep.

Drill exploratory holes using rotary diamond drilling equipment. Diamond drills shall be equipped with hydraulic heads and be capable of drilling 1.78 inches (NQ) diameter core. Both vertical and inclined holes will be required. Coring operations will be performed using triple-tube swivel type core barrels. The core will be boxed by the CONTRACTOR and logged by the ENGINEER.

All drilling equipment shall produce a smooth, round hole, free of irregularities which may cause leakage around packer.

#### B. Grouting Equipment

Grout plant and equipment shall include the following items:

- Grouting equipment shall be capable of satisfactorily supplying, mixing, stirring, pumping, and injecting grout mixes of diverse viscosities.
- Equipment shall be adequate in size and capable of injecting an uninterrupted flow of grout at the rate of 30 gpm at any pressure up to 200 psi as measured at the collar of the grout hole.
- Equipment shall be maintained in first class operating condition at all times. Lost or plugged grout holes due to mechanical failure of equipment or inadequacy of grout supply shall be replaced, at no cost to AUTHORITY.
- Hoses and supply lines for pressure grouting shall have a minimum inside diameter of 1 3/8 inches.
- Grout pumps shall be continuous cavity type or other pumps, approved by ENGINEER, capable of maintaining steady pressures up to 200 psi at the grout hole collar. They shall be capable of pumping thick mixes of various combinations of cement, bentonite, flyash, sand and water.
- Compressors shall be of a type capable of delivering compressed air to each piece of pneumatic equipment at a pressure not less than 85 psi.
- Grout mixers shall have a minimum capacity of 200 gallons and shall be colloidal high speed impeller type or other as approved by ENGINEER. They shall be capable of mixing thick mixes of various combinations of cement, bentonite, flyash and water.

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- Sump or holdover tanks shall have a minimum capacity of 200 gallons and shall be mechanically operated and designed to keep mixed grout agitated and in suspension, and equipped with suitable screens, as approved by ENGINEER. The sump shall be graduated in five (5) gallon increments so that the volume of grout injected into a hole can be measured accurately.
- Mixers shall be equipped with water meters graduated in gallons without bypass so that the water can be measured directly into mixer.
- Pressure gauges shall be of the Bourdon or any other suitable type with grout protection mechanisms and shall be of such calibration as to cover a range of pressures from zero (0) psi to 100 psi and from zero (0) psi to 200 psi as approved by ENGINEER. An adequate number of spare gauges shall be provided at each grout plant. Gauges which have been in use for over 1000 feet of grouted holes shall be recalibrated.
- Packers shall be of a type approved by ENGINEER including single packer type and double packer assemblies and expandable tubes. Packers shall be capable of sealing the hole at any setting and to withstand, without leakage, pressures up to and including 250 psi.

### C. Pressure Testing Equipment

Pressure testing equipment shall include single packer type and double packer type water pressure test assemblies, water storage facilities, flow meters, pressure gauges including gauge savers, valves, hose, fittings and pumps capable of operating at a maximum discharge pressure of 250 psi and maintaining constant pressure. Type of packer shall be varied to suit rock conditions, as required by ENGINEER. Packers will be used either singly or in pairs, separated by perforated pipe.

### 5.3 Performance

#### A. Protection

Cement, bentonite and flyash shall be stored immediately upon receipt at the job site, and in a thoroughly dry, weather tight, and properly ventilated enclosure having adequate provisions for preventing cement and bentonite from absorbing moisture. Storage shall permit ease of access for inspection, and permit identification of each shipment.

Each hole shall be protected from clogging or obstruction by means of a temporary cap or other suitable means at the collar, and any grout hole that becomes clogged or otherwise obstructed shall be cleaned out before completion of the grouting operation in a manner acceptable to ENGINEER, or another hole shall be provided at no additional cost.

No drilling shall be performed within 40 feet of grout holes during grouting operations.

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A minimum interval of 12 hours shall elapse before drilling and grouting additional holes midway between holes within a single line which have previously been drilled and grouted. In a multiple row grout pattern, a minimum interval of 12 hours shall elapse before drilling and grouting additional holes in the adjacent line that are directly opposite holes which have been previously drilled and grouted.

In the Down-Stage grouting procedure, a minimum interval of 24 hours shall elapse before each successive stage of the hole.

### B. Equipment Arrangement and Operation

Arrangement of grouting equipment shall be such as to provide a continuous circulation of grout throughout the system and to permit accurate pressure control by operation of valves on grout pumps, on grout connections at the holes and on grout return lines. It may be necessary to use a single line system directly into a grout hole. At times ENGINEER may require that grouting be conducted by permitting grout to flow freely into holes by the gravity method. Grout pump will be located as close as practicable to the hole being grouted using minimum length of line.

Fouling of equipment and lines shall be prevented by maintaining a continuous flow of grout and by periodic flushing with water. Pressure gauges and valves for bypass and shut-off shall be attended by experienced operators.

### C. Drilling

Location, alignment, sequence of drilling, spacing, and depth of all holes will be as shown on the Drawings. Split spaced holes will be determined by the takes in adjacent holes as directed by the ENGINEER. In general, the depth of grout holes will be up to 50 feet and not exceed a total of 100 feet from the base of the core trench.

Use of grease, rod dope or other lubricants will not be permitted.

All holes for curtain grouting shall be a minimum of two inches in diameter in rock.

Drilling operations may be stopped at ENGINEER's discretion if drill water is lost. Such an occurrence shall warrant grouting of drill hole before drilling operations can be resumed.

Some drill holes may need to be temporarily cased to remain open prior to and during the grouting process.

Obstructed drill holes prior to grouting shall be cleaned out, or another hole provided at CONTRACTOR's expense.

### D. Flushing

Before water pressure testing or pressure grouting of any hole is started, thoroughly flush each hole with clean water for a minimum period of five (5) minutes to remove any accumulation of drilling sludge, cuttings and joint filling materials, if any, by flushing through a pipe inserted to the bottom

## TECHNICAL SPECIFICATION

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of hole. A hole will be considered clean when return water is clear and free of cuttings or to satisfaction of ENGINEER.

Upon completion of flushing, cap hole to prevent entry of foreign material.

#### E. Water Pressure Testing

Holes to be water pressure tested shall have their entire lengths tested in sections. Isolate each section for pressure testing by means of two packers, spaced a maximum distance of ten (10) feet apart. Apply water pressures in three increments up to maximum specified grouting pressure continuously in turn to each isolated section for a minimum period of five (5) minutes per pressure increment and measure any water loss to an accuracy of 0.1 gallons.

#### F. Grouting

##### 1. Grout Slurry Mix

The grout slurry shall be a uniform stable mix of cement and bentonite in water that has a viscosity sufficiently low to be easily pumped into the rock cracks and solution cavities but not so low as to travel long distances without appreciable pressure drop.

Prior to, and at the start of grouting, a number of tests and trials will be made on a variety of grout mixes. In general, however, the grout mix used at the start and finish of any section of a curtain grout hole shall be a cement bentonite grout with a water-cement ratio of 4:1 by volume. This starting mix shall be injected at the specified pressure with the grout pump operating as nearly as possible at constant speed. If the rate of absorption of cement is observed to drip steadily, the starting mix will continue to be injected until refusal is reached. If the absorption of solids is high during the initial period, the water-cement ratio of the mix shall be steadily decreased until grout consumption stabilizes or begins to decrease. If absorption of the thicker mixes begins to decrease, or cause the pressure to rise above the specified limits, the water-cement ratio of the mix shall be increased until refusal is reached.

All mixes shall contain a minimum of 2% bentonite by dry weight of cement. The bentonite shall be pre-mixed with about 14% - 15% of water and aged for at least 2 hours before adding to the grout slurry.

Field tests shall be conducted on each of the mixes during the trial grouting program for sedimentation, slurry density, Marsh Funnel viscosity and unconfined compressive strength at 7, 14 and 28 days. The tests shall be conducted on 4:1 (water/cement); 2:1 (water/cement); 0.75:1:0.5 (water/cement/flyash) mixes. Other field test mixes may be included as directed by the ENGINEER. All mixes shall contain a minimum of 3% of hydrolyzed bentonite. At least three samples for each test shall be taken from each mix design for analysis. The tests shall be conducted by the Specialist Grouting Contractor under the supervision of the ENGINEER using the same materials (cement, bentonite, flyash and water) that will be used in the production grouting program.

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During production grouting, grout samples shall be obtained hourly from the agitator or grout by-pass valve at the head of the hole and the following three tests shall be conducted by the Specialist Grouting Contractor: temperature of the slurry, density of the slurry and Marsh Funnel viscosity. Sedimentation tests shall be performed at least twice per shift. The results of these tests shall be reported by the Specialist Grouting Contractor on the daily field report to be submitted to the ENGINEER. Samples for compressive strength tests at 7, 14 and 28 days shall be taken at a minimum of one set per 40 hour work period.

The grout slurry mix shall meet the following minimum requirements:

<u>Type of Test</u>	<u>Standard</u>	<u>Frequency</u>	<u>Specified Values</u>
Sedimentation	Liter of grout in 1000-ml graduated cylinder	2 per shift (2 hour test)	25% (max)
Slurry Density	API Std. 13B	Hourly	75 lbs/ft <sup>3</sup> (min)
Marsh Viscosity	API Std. 13B	Hourly	30 sec.
Unconfined Compressive Strength	ASTM C109-87	1 per 40 hour period	700 lbs/in <sup>2</sup> (min)

### 2. Operation

Generally, the up-stage grouting method shall be used. CONTRACTOR shall make every attempt and, if necessary, install temporary casing to keep holes open. However, down-stage grouting may be required for certain holes at ENGINEER's discretion. Specified pressures shall be made at the collar location.

The grout mix used at the start and finish of any section of a hole shall be cement-bentonite grout with a water-cement ratio of 4:1 by apparent volume. The starting mix shall be injected for 10 minutes. If the rate of absorption of the starting mix drops steadily, pumping shall be continued until refusal is reached. If the absorption of the starting mix is high, the water-cement ratio shall be gradually decreased. Successfully thicker mixes shall be injected for 10-minute periods until grout consumption stabilizes or begins to decrease. When absorption of thicker mixes begins to decrease, the water-cement ratio shall be increased. Refusal shall be considered to be reached when absorption of a 4:1 mix does not exceed a total of 3 gallons of mix per 10 ft. section over a 10-minute period.

All mixes shall have a minimum of 3% by dry weight of cement of hydrolyzed bentonite. The bentonite shall be fully hydrolyzed (for approximately 2-3 hours) before it is added to the water/cement mix.

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If it is found impossible to reach the required pressure after pumping, a reasonable volume of grout within a stage (say 2000 lb. of cement) at a water-cement ratio of 1:1, the rate of pumping shall be reduced or pumping stopped temporarily to allow sufficient time between injections for the grout to stiffen.

Mix grout in batches of suitable volume and in such a way as to enable water-cement ratios, compositions and viscosities of grouts to be changed, and to ensure continuous flow and minimum wastage.

Mix cement, cement-flyash, and cement-sand grouts for a minimum of three (3) minutes before injection. Agitate grout continuously to prevent settling or sedimentation between the time of mixing and injection. All grout which cannot be injected within two (2) hours of mixing shall be wasted.

Grouting pressures of 1 psi per foot of depth will generally be used throughout the grouting program. However, this criteria may vary at depth up to 1.5 psi per foot depth, but only as directed by ENGINEER, and not exceeding 200 psi.

Grout holes in ten (10) feet stages, except as otherwise directed by ENGINEER. During the grouting of any hole, if grout is found to flow from adjacent grout holes, CONTRACTOR shall be prepared to make an immediate hook-up to the flowing holes for simultaneous grouting of up to a total of three (3) holes.

Before grout has reached its initial set, connect grout line to adjacent capped holes, and other holes from which grout flow was observed, and grouting of all holes shall be completed at pressures specified. When grout returns from any adjacent hole, CONTRACTOR may set a packer in proper zone of adjacent hole and grout simultaneously, maintaining required pressure.

During grouting of any one single stage in a hole, if the number of bags of cement injected exceeds 20 bags, whatever the mix, ENGINEER may direct CONTRACTOR to interrupt grouting to allow the injected grout to settle and partially set before resuming grouting.

CONTRACTOR shall take suitable measures to prevent grouting packer in place or grout setting completely in hole prior to completion of the hole.

After grouting of any stage of hole is complete, if back pressure exists, maintain pressure therein by means of a valve until grout in hole has taken its initial set, as determined by ENGINEER.

Backfill all holes from bottom to top of rock with 1:1 by volume water-cement grout mix. Each hole shall be "topped up" with additional bentonite-cement slurry.

### 3. Down-Stage Grouting

In the Down-Stage grouting procedure, drill each stage to the required depth, wash and grout to that depth and then clear the hole by washing or other suitable means just after grout surrounding the hole has reached initial set. Drill the hole to another limited depth and repeat the washing and grouting procedure. This procedure shall be continued throughout the remainder of the hole.

# TECHNICAL SPECIFICATION

## DIVISION 02260 - DRILLING AND PRESSURE GROUTING

However, a minimum interval of 24 hours shall elapse before grouting each successive stage of the hole. During grouting, set the packer for each successive stage at the bottom of the preceding (old) stage so as not to cover any discontinuities that may exist at the top of the lower (new) stage.

When the bottom stage is finished, the hole shall be backfilled from bottom to top with a 1:1 by volume water-cement grout mix. Each hole shall be "topped up" with additional bentonite-cement slurry.

### 4. Curtain Grouting

Drilling and grouting of holes for curtain grouting shall be done in the sequence shown on the Drawings, using split-spacing method. Primary holes will be spaced as directed and shall be drilled, washed and grouted before intermediate holes are drilled and grouted. Initial work on primary holes may be concentrated in more than one location along curtain axis. Complete drilling and grouting of all holes with such final spacing as grouting results show to be necessary, as determined by ENGINEER.

Drill curtain grouting holes to the depths shown on the Drawings or as directed by ENGINEER. Curtain grouting holes shall be up-stage grouted at pressures up to one (1) psi/ft of depth to 20 feet below top of rock and as directed by ENGINEER up to 1.5 psi/ft of depth for remainder to final depth, not exceeding 200 psi.

### 5. Refusal Criterion

Injection of grout into any hole and for any ten (10) feet long single stage shall be continued until hole takes a 4:1 water-cement grout at a rate of less than 3.0 gallon in ten (10) minutes at maximum pressure specified for this stage. This absorption shall be applied as criterion for refusal.

### 6. Grouting in Freezing Temperatures

Grouting operations shall be scheduled and performed in such a manner that it can be made certain that during these operations rock to be grouted is not frozen and that joints, cracks, and fissures in rock to be grouted contain no frozen materials.

Grout shall not be injected into frozen rock; however, grout may be injected through holes drilled in frozen rock into zones not subjected to freezing. Grouting in rock which, in the ENGINEER's opinion, may be subjected to freezing, shall be completed when rock is not frozen. Drilling and grouting through embankment is not authorized.

During cold weather, water and grouting materials shall be heated to the extent required, a heated shelter shall be provided for workers and equipment, and all other necessary precautions shall be taken to ensure uninterrupted continuation of work in accordance with this Specification.

# TECHNICAL SPECIFICATION

## DIVISION 02260 - DRILLING AND PRESSURE GROUTING

### G. Cleaning

During operations, provide for adequate disposal of all wash and waste water and remove all waste grout caused by this operation.

Wastes shall not be allowed to contaminate placed embankments.

### 6.0 METHOD OF MEASUREMENT

Measurement for Work of this Division of the Specifications will be made as follows:

- Total length of 2-inch minimum diameter grout hole drilled and washed, from concrete or rock surface to bottom of such holes drilled including set-up over hole. Vertical and inclined drill hole will be measured as the same.
- Total length of exploratory holes drilled in rock and cored including set-up over hole (1.78 inches (NQ) diameter core) and core boxes supplied, from the concrete or rock surface to bottom of such holes drilled. Vertical and inclined holes will be measured as the same.
- Number of packers successfully set and connections for water pressure testing and pressure grouting made in grout holes and exploratory holes.
- Weight of dry cement and bentonite supplied, mixed and injected, or mixed and not injected because of refusal, measured by the number of 94-lb. bags.
- Weight of flyash or dry sand supplied, mixed in cement grout and injected, or mixed in cement grout and not injected because of refusal.
- Total length of decommissioning existing exploratory boreholes/piezometers within the reservoir pool, principal/emergency spillway, and embankment areas by augering out piezometer tube and well casing and backfilling with a 1:1 grout mix with the packer set at the top of rock (see Division 02280, Method of Measurement and Basis of Payment).
- Number of additional set-ups over a downstage grout hole to drill, wash, and grout deeper stages after the initial surface stage has been successfully drilled, washed, grouted, and cleaned.

### 7.0 BASIS OF PAYMENT

Payment for Work of this Division of the Specifications will be made under the following Items of the Unit Price / Lump Sum Schedule:

- Item 02260/01 will cover 2-inch minimum diameter grout holes from concrete or rock surface to a depth of 50 feet.
- Item 02260/02 will cover 2-inch minimum diameter grout holes from 50 feet to 100 feet in depth.

## TECHNICAL SPECIFICATION

### DIVISION 02260 - DRILLING AND PRESSURE GROUTING

- Item 02260/03 will cover exploratory holes.
- Item 02260/04 will cover setting packers and time to perform water pressure testing.
- Item 02260/05 will cover each setting and connection of packer assemblies for grouting.
- Item 02260/06 will cover injecting cement grout mixes.
- Item 02260/07 will cover mixing bentonite in cement grout mixes.
- Item 02260/08 will cover mixing flyash in cement grout mixes.
- Item 02260/09 will cover mixing sand in cement grout mixes.
- Item 02260/10 will cover additional set-ups of drilling and grouting equipment over a down-stage grout hole.
- Items 02260/01 to 02260/02, will also cover drilling and washing of grout holes through grout which has been allowed to harden in the grout holes, in accordance with instructions from ENGINEER.
- Where grout pipes are installed in concrete structures to accommodate future grouting operations, payment will be made for length of drilling which is replaced thereby.
- No additional compensation will be made for drilling angle holes.
- No additional compensation will be made for caulking or sealing rock fractures or construction joints from which grout emanates during grouting operations.
- Item 02280/01 will cover decommissioning of existing exploratory boreholes/piezometers within the reservoir pool, principal/emergency spillway and embankment areas.

No additional compensation will be made for the following:

- 1) Temporary casing of drill holes.
- 2) Re-drilling, reaming and re-washing of holes, unless required through grout which has been allowed to harden in the grout holes in accordance with instructions from the ENGINEER.
- 3) Disposal of waste material and maintaining work areas clean.
- 4) Furnishing and using accessories such as pipe fittings, valves, gauges, gauge savers, pipe caps, grout nipples, appurtenant equipment for moving equipment and supplies on Site, keeping records, communications and like items.
- 5) Processing, supplying, mixing, and pumping grout.

# TECHNICAL SPECIFICATION

## DIVISION 02260 - DRILLING AND PRESSURE GROUTING

No differentiation shall be made in payment for up-stage grouting and down-stage grouting. Payment for grouting by either method will be included in applicable Contract Unit Prices.

The quantities for drilling and pressure grouting are very uncertain, and the CONTRACTOR shall be entitled to no additional compensation above the price bids in the Unit Price / Lump Sum Schedule, except as defined in the General Conditions of the Contract, for increased or decreased quantities.

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RE: [Fwd: well construction 2C rules]

**Subject:** RE: [Fwd: well construction 2C rules]  
**From:** "Bill Greco" <bill@landsolutionspc.com>  
**Date:** Mon, 11 Jul 2005 19:02:05 -0400  
**To:** "Jim Barber" <Jim.Barber@ncmail.net>

Jim

Thanks for the information and for answering my questions.  
Assuming our client gets this job, I am sure we will discuss things  
further.

Bill

**SUBCHAPTER 2C - WELL CONSTRUCTION STANDARDS**

**SECTION .0100 - CRITERIA AND STANDARDS APPLICABLE TO WATER-SUPPLY AND CERTAIN OTHER TYPE WELLS**

**15A NCAC 02C .0101 GENERAL PROVISIONS**

(a) Authorization. The North Carolina Environmental Management Commission is required, under the provisions of Chapter 87, Article 7, Section 87, General Statutes of North Carolina (short title: North Carolina Well Construction Act) to adopt appropriate rules governing the location, construction, repair, and abandonment of wells, and the installation and repair of pumps and pumping equipment.

(b) Purpose. Consistent with the duty to safeguard the public welfare, safety, health, and to protect and beneficially develop the groundwater resources of the state, it is declared to be the policy of this state to require that the location, construction, repair and abandonment of wells, and the installation of pumps and pumping equipment conform to such reasonable standards and requirements as may be necessary to protect the public welfare, safety, health, and ground water resources.

*History Note: Authority G.S. 87-87;  
Eff. February 1, 1976;  
Amended Eff. December 1, 1992; July 1, 1988.*

**15A NCAC 02C .0102 DEFINITIONS**

As used herein, unless the context otherwise requires:

- (1) "Abandon" means to discontinue the use of and to seal the well according to the requirements of 15A NCAC 2C .0113 of this Section.
- (2) "Access port" means an opening in the well casing or well head installed for the primary purpose of determining the position of the water level in the well.
- (3) "Agent" means any person who by mutual and legal agreement with a well owner has authority to act in his behalf in executing applications for permits. The agent may be either general agent or a limited agent authorized to do one particular act.
- (4) "ASTM" means the American Society for Testing and Materials.
- (5) "Casing" means pipe or tubing constructed of specified materials and having specified dimensions and weights, that is installed in a borehole, during or after completion of the borehole, to support the side of the hole and thereby prevent caving, to allow completion of a well, to prevent formation material from entering the well, to prevent the loss of drilling fluids into permeable formations, and to prevent entry of contamination.
- (6) "Clay" means a substance comprised of natural, inorganic, finely ground crystalline mineral fragments which, when mixed with water, forms a pasty, moldable mass that preserves its shape when air dried.
- (7) "Commission" means the North Carolina Environmental Management Commission or its successor, unless otherwise indicated.
- (8) "Consolidated rock" means rock that is firm and coherent, solidified or cemented, such as granite, gneiss, limestone, slate or sandstone, that has not been decomposed by weathering.
- (9) "Contamination" means the introduction of foreign materials of such nature, quality, and quantity into the groundwaters as to exceed the groundwater quality standards specified in 15A NCAC 2L (Classifications and Water Quality Standards Applicable to the Groundwaters of North Carolina).
- (10) "Department" means the Department of Environment and Natural Resources.
- (11) "Designed capacity" shall mean that capacity that is equal to the yield that is specified prior to construction of the well.
- (12) "Director" means the Director of the Division of Water Quality.
- (13) "Division" means the Division of Water Quality.
- (14) "Domestic use" means water used for drinking, bathing, or other household purposes, livestock, or gardens.
- (15) "Formation Material" means naturally occurring material generated during the drilling process that is composed of sands, silts, clays or fragments of rock and which is not in a dissolved state.
- (16) "GPM" and "GPD" mean gallons per minute and gallons per day, respectively.
- (17) "Grout" shall mean and include the following:
  - (a) "Neat cement grout" means a mixture of not more than six gallons of clear, potable water to one 94 pound bag of portland cement. Up to five percent, by weight, of bentonite clay may be used to improve flow and reduce shrinkage.

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Fax #		Fax #	5:22PM		

- (b) "Sand cement grout" means a mixture of not more than two parts sand and one part cement and not more than six gallons of clear, potable water per 94 pound bag of portland cement.
  - (c) "Concrete grout" means a mixture of not more than two parts gravel to one part cement and not more than six gallons of clear, potable water per 94 pound bag of portland cement. One hundred percent of the gravel must pass through a one-half inch mesh screen.
  - (d) "Gravel cement grout, sand cement grout or rock cutting cement grout" means a mixture of not more than two parts gravel and sand or rock cuttings to one part cement and not more than six gallons of clear, potable water per 94 pound bag of portland cement.
  - (e) "Bentonite grout" means the mixture of no less than one and one-half pounds of commercial bentonite with sufficient clear, potable water to produce a grout weighing no less than 9.4 pounds per gallon of mixture. Non-organic, non-toxic substances may be added to improve particle distribution and pumpability. Bentonite grout may only be used in those instances where specifically approved in this Section and only as recommended by the manufacturer.
  - (f) "Specialty grout" means a mixture of non-organic, non-toxic materials with characteristics of expansion, chemical-resistance, rate or heat of hydration, viscosity, density or temperature-sensitivity applicable to specific grouting requirements. Specialty grouts may not be used without prior approval by the Director. Approval of the use of specialty grouts shall be based on a demonstration that the mixture will not adversely impact human health or the environment.
- (18) "Liner pipe" means pipe that is installed inside a completed and cased well for the purpose of preventing the entrance of contamination into the well or for repairing ruptured or punctured casing or screens.
  - (19) "Monitoring well" means any well constructed for the primary purpose of obtaining samples of groundwater or other liquids for examination or testing, or for the observation or measurement of groundwater levels. This definition excludes lysimeters, tensiometers, and other devices used to investigate the characteristics of the unsaturated zone but includes piezometers, a type of monitor well constructed solely for the purpose of determining groundwater levels.
  - (20) "Owner" means any person who holds the fee or other property rights in the well being constructed. A well is real property and its construction on land rests ownership in the land owner in the absence of contrary agreement in writing.
  - (21) "Pitless adapters" or "pitless units" are devices specifically manufactured to the standards specified under 15A NCAC 2C .0107(i)(5) of this Section for the purpose of allowing a subsurface lateral connection between a well and plumbing appurtenances.
  - (22) "Public water system" means a water system as defined in 15A NCAC 18C (Rules Governing Public Water Supplies).
  - (23) "Recovery well" means any well constructed for the purpose of removing contaminated groundwater or other liquids from the subsurface.
  - (24) "Settleable solids" means the volume of solid particles in a well-mixed one liter sample which will settle out of suspension, in the bottom of an Imhoff Cone, after one hour.
  - (25) "Site" means the land or water area where any facility, activity or situation is physically located, including adjacent or nearby land used in connection with the facility, activity or situation.
  - (26) "Specific capacity" means the yield of the well expressed in gallons per minute per foot of draw-down of the water level (gpm/ft.-dd) per unit of time.
  - (27) "Static water level" means the level at which the water stands in the well when the well is not being pumped and is expressed as the distance from a fixed reference point to the water level in the well.
  - (28) "Suspended solids" means the weight of those solid particles in a sample which are retained by a standard glass microfiber filter, with pore openings of one and one-half microns, when dried at a temperature of 103 to 105 degrees Fahrenheit.
  - x (29) "Temporary well" means a well, other than a water supply well, that is constructed to determine aquifer characteristics, and which will be properly abandoned or converted to a permanent well within five days (120 hours) of the completion of drilling of the borehole.
  - (30) "Turbidity" means the cloudiness in water, due to the presence of suspended particles such as clay and silt, that may create esthetic problems or analytical difficulties for determining contamination. Turbidity, measured in Nephelometric Turbidity Units (NTU), is based on a comparison of the cloudiness in the water with that in a specially prepared standard.

- (31) "Vent" means an opening in the well casing or well head, installed for the purpose of allowing changes in the water level in a well due to natural atmospheric changes or to pumping. A vent can also serve as an access port.
- ~~(32)~~ "Well" means any excavation that is cored, bored, drilled, jetted, dug or otherwise constructed for the purpose of locating, testing, developing, draining or recharging any groundwater reservoirs or aquifer, or that may control, divert, or otherwise cause the movement of water from or into any aquifer.
- (33) "Well capacity" shall mean the maximum quantity of water that a well will yield continuously as determined by methods outlined in 15A NCAC 2C .0110.
- (34) "Well head" means the upper terminal of the well including adapters, ports, valves, seals, and other attachments.
- (35) "Well system" means two or more cross-connected wells.
- (36) "Yield" means the amount of water or other fluid that can be extracted from a well under a given set of conditions.

*History Note: Authority G.S. 87-85; 87-87; 143-214.2; 143-215.3;  
Eff. February 1, 1976;  
Amended Eff. April 1, 2001; December 1, 1992; July 1, 1988; March 1, 1985; September 1, 1984.*

### **15A NCAC 02C .0103 REGISTRATION**

#### **Pump Installer Registration:**

- (1) All persons, firms, or corporations engaged in the business of installing or repairing pumps or other equipment in wells shall register bi-annually with the Department.
- (2) Registration shall be accomplished, during the period from April 1 to April 30 of every odd-numbered year, by completing and submitting to the department a registration form provided by the department for this purpose.
- (3) Upon receipt of a properly completed application form, the applicant will be issued a certificate of registration.

*History Note: Authority G.S. 87-87; 143-215.3(a)(1a); 143-355(e);  
Eff. February 1, 1976;  
Amended Eff. April 1, 2001; December 1, 1992; July 1, 1988; April 20, 1978.*

### **15A NCAC 02C .0104 PUMP INSTALLATION REGISTRATION**

*History Note: Authority G.S. 87-87;  
Eff. February 1, 1976;  
Repealed Eff. July 1, 1988.*

### **15A NCAC 02C .0105 PERMITS**

(a) It is the finding of the Commission that the entire geographical area of the state is vulnerable to groundwater pollution from improperly located, constructed, operated, altered, or abandoned non-water supply wells and water supply wells not constructed in accordance with the standards set forth in 15A NCAC 2C .0107 of this Section. Therefore, in order to ensure reasonable protection of the groundwater resources, prior permission from the Division must be obtained for the construction of the types of wells enumerated in Paragraph (b) of this Rule.

- (b) No person shall locate or construct any of the following wells until a permit has been issued by the Director:
- (1) any water-well or well system with a design capacity of 100,000 gallons per day (gpd) or greater;
  - (2) any well added to an existing system where the total design capacity of such existing well system and added well will equal or exceed 100,000 gpd;
  - (3) any monitoring well, constructed to assess the impact of an activity not permitted by the state, when installed on property other than that on which the unpermitted activity took place;
  - (4) any recovery well;
  - (5) any well for recharge or injection purposes;
  - (6) any well with a design deviation from the standards specified under the rules of this Subchapter.

- (12) After the completion of the pumping period, measurements of the water level recovery rate, in the pumped well, shall be made for a period of at least two hours in the same manner as the drawdown.

*History Note: Authority G.S. 87-87; 87-88;  
Eff. February 1, 1976;  
Amended Eff. April 1, 2001; December 1, 1992; September 1, 1984; April 20, 1978.*

#### **15A NCAC 02C .0111 DISINFECTION OF WATER SUPPLY WELLS**

All water supply wells shall be disinfected upon completion of construction, maintenance, repairs, pump installation and testing as follows:

- (1) Chlorination.
- (a) Chlorine shall be placed in the well in sufficient quantities to produce a chlorine residual of at least 100 parts per million (ppm) in the well. A chlorine solution may be prepared by dissolving high test calcium hypochlorite (trade names include HTH, Chlor-Tabs, etc.) in water. Do not use stabilized chlorine tablets or hypochlorite products containing fungicides, algaecides, or other disinfectants. Follow manufacturers directions with storing, transporting, and using calcium hypochlorite products. About three ounces of hypochlorite containing 65 percent to 75 percent available chlorine is needed per 100 gallons of water for at least a 100 ppm chlorine residual. As an example, a well having a diameter of six inches, has a volume of about 1.5 gallons per foot. If the well has 200 feet of water, the minimum amount of hypochlorite required would be 9 ounces. (1.5 gallons/foot x 200 feet = 300 gallons at 3 ounces per 100 gallons; 3 ounces x 3 = 9 ounces.)
- (b) The chlorine shall be placed in the well by one of the following or equivalent methods:
- (i) Chlorine tablets may be dropped in the top of the well and allowed to settle to the bottom;
- (ii) Chlorine solutions shall be placed in the bottom of the well by using a bailer or by pouring the solution through the drill rod, hose, or pipe placed in the bottom of the well. The solution shall be flushed out of the drill rod, hose, or pipe by using water or air.
- (c) Agitate the water in the well to ensure thorough dispersion of the chlorine.
- (d) The well casing, pump column and any other equipment above the water level in the well shall be thoroughly rinsed with the chlorine solution as a part of the disinfecting process.
- (e) The chlorine solution shall stand in the well for a period of at least 24 hours.
- (f) The well shall be pumped until the system is clear of the chlorine before the system is placed in use.
- (2) Other materials and methods of disinfection, at least as effective as those in Item (1) of this Rule, may be used upon prior approval by the Director.

*History Note: Authority G.S. 87-87; 87-88;  
Eff. February 1, 1976;  
Amended Eff. April 1, 2001; December 1, 1992; July 1, 1988; September 1, 1984.*

#### **15A NCAC 02C .0112 WELL MAINTENANCE: REPAIR: GROUNDWATER RESOURCES**

- (a) Every well shall be maintained by the owner in a condition whereby it will conserve and protect the groundwater resources, and whereby it will not be a source or channel of contamination or pollution to the water supply or any aquifer.
- (b) All materials used in the maintenance, replacement, or repair of any well shall meet the requirements for new installation.
- (c) Broken, punctured or otherwise defective or unserviceable casing, screens, fixtures, seals, or any part of the well head shall be repaired or replaced, or the well shall be abandoned pursuant to the requirements of 15A NCAC 02C .0113.
- (d) National Science Foundation (NSF) approved PVC pipe rated at 160 PSI may be used for liner casing. The annular space around the liner casing shall be at least five-eighths inches and shall be completely filled with neat-cement grout. The well liner shall be completely grouted within 10 working days after the liner has been installed.

*History Note: Authority G.S. 87-87; 87-88;  
Eff. February 1, 1976;  
Amended Eff. August 1, 2002; April 1, 2001; December 1, 1992; September 1, 1984.*

#### **\* 15A NCAC 02C .0113 ABANDONMENT OF WELLS**

- \* (a) Any well which has been temporarily abandoned, shall be abandoned in accordance with one of the following procedures:
- (1) Upon temporary removal from service or prior to being put into service, the well shall be sealed with a water-tight cap or seal compatible with casing and installed so that it cannot be removed easily by hand.
  - (2) The well shall be maintained whereby it is not a source or channel of contamination during temporary abandonment.
  - (3) Every temporarily abandoned well shall be protected with a casing.
- (b) Any well which has been abandoned permanently shall be abandoned in accordance with the following procedures:
- (1) Procedures for permanent abandonment of wells, other than bored and hand dug wells:
    - (A) All casing and screen materials may be removed prior to initiation of abandonment procedures if such removal will not cause or contribute to contamination of the groundwaters. Any casing not grouted in accordance with 15A NCAC 2C .0107(e) of this Section shall be removed or properly grouted.
    - (B) The entire depth of the well shall be sounded before it is sealed to ensure freedom from obstructions that may interfere with sealing operations.
    - (C) Using a hypochlorite solution (such as HTH), disinfect the well in accordance with 15A NCAC 2C .0111. Do not use a common commercial household liquid bleach, as this is too weak a solution to ensure proper disinfection.
    - (D) In the case of gravel-packed wells in which the casing and screens have not been removed, neat-cement, or bentonite grout shall be injected into the well completely filling it from the bottom of the casing to the top.
    - (E) Wells, other than "bored" wells, constructed in unconsolidated formations shall be completely filled with cement grout, or bentonite grout by introducing it through a pipe extending to the bottom of the well which can be raised as the well is filled.
    - (F) Wells constructed in consolidated rock formations or that penetrate zones of consolidated rock may be filled with cement grout, bentonite grout, sand, gravel or drill cuttings opposite the zones of consolidated rock. The top of the cement grout, bentonite grout, sand, gravel or cutting fill shall terminate at least 10 feet below the top of the consolidated rock or five feet below the bottom of casing. Cement grout or bentonite grout shall be placed beginning 10 feet below the top of the consolidated rock or five feet below the bottom of casing and extend five feet above the top of consolidated rock. The remainder of the well, above the upper zone of consolidated rock, shall be filled with cement grout or bentonite grout up to land surface. For any well in which the depth of casing or the depth of the bedrock is not known or cannot be confirmed, then the entire length of the well shall be filled with cement grout or bentonite grout up to land surface.
    - (G) Temporary wells or monitor wells:
      - (i) less than 20 feet in depth which do not penetrate the water table shall be abandoned by filling the entire well up to land surface with cement grout, dry clay, bentonite grout, or material excavated during drilling of the well and then compacted in place; and
      - (ii) that penetrate the water table shall be abandoned by completely filling with a bentonite or cement - type grout.
  - (2) For bored wells or hand dug wells, constructed into unconsolidated material.
    - (A) For wells that do not have standing water in them at any time during the year:
      - (i) Remove all plumbing or piping entering the well, along with any obstructions in the well;
      - (ii) Remove as much of the well casing as possible and then fill the entire well up to land surface with cement grout, concrete grout, bentonite grout, dry clay, or material excavated during drilling of the well and then compacted in place.
    - (B) For wells that do have standing water in them during all or part of the year:
      - (i) Remove all plumbing or piping into the well, along with any obstructions inside the well; and
      - (ii) Remove as much of the well tile casing as possible, but no less than to a depth of three feet below land surface;
      - (iii) Remove all soil or other subsurface material present down to the top of the remaining well casing, and extending to a width of at least 12 inches outside of the well casing on all sides;

- (iv) Using a hypochlorite solution (such as HTH), disinfect the well in accordance with 15A NCAC 2C .0111 of this Subchapter. Do not use a common commercial household liquid bleach, as this is too weak a solution to ensure proper disinfection;
  - (v) Fill the well up to the top of the remaining casing with cement grout, concrete grout, bentonite grout, dry clay, or material excavated during drilling of the well and then compacted in place;
  - (vi) Pour a one foot thick concrete grout or cement grout plug that fills the entire excavated area above the top of the casing, including the area extending on all sides of the casing out to a width of at least 12 inches on all sides; and
  - (vii) Complete the abandonment process by filling the remainder of the well above the concrete or cement plug with additional concrete grout, cement grout, or soil.
- (c) Any well which acts as a source or channel of contamination shall be repaired or permanently abandoned within 30 days of receipt of notice from the department.
- (d) The drilling contractor shall permanently abandon any well in which the casing has not been installed or from which the casing has been removed, prior to removing his equipment from the site.
- (e) The owner shall be responsible for permanent abandonment of a well except that:
- (1) the well driller is responsible for well abandonment if abandonment is required because the driller improperly locates, constructs, repairs or completes the well; or
  - (2) the person who installs, repairs or removes the well pump is responsible for well abandonment if that abandonment is required because of improper well pump installation, repair or removal.

*History Note: Authority G.S. 87-87; 87-88;  
Eff. February 1, 1976;  
Amended Eff. April 1, 2001; December 1, 1992; September 1, 1984; April 20, 1978.*

#### **15A NCAC 02C .0114 DATA AND RECORDS REQUIRED**

##### **(a) Well Cuttings.**

- (1) Samples of formation cuttings shall be collected and furnished to the Division from any well when such samples are requested by the Division prior to completion of the drilling or boring activities.
- (2) Samples or representative cuttings shall be obtained for depth intervals of 10 feet or less beginning at the land surface. Representative cuttings shall also be collected at depths of each significant change in formation.
- (3) Samples of cuttings shall be placed in containers furnished by the Division and such containers shall be filled, sealed and properly labeled with indelible-type markers, showing the well owner, well number if applicable, and depth interval the sample represents.
- (4) Each set of samples shall be placed in a suitable container(s) showing the location, owner, well number if applicable, driller, depth interval, and date.
- (5) Samples shall be retained by the driller until delivery instructions are received from the Division or for a period of at least 60 days after the well record form (GW-1), indicating said samples are available, has been received by the Division.
- (6) The furnishing of samples to any person or agency other than the Division shall not constitute compliance with the department's request and shall not relieve the driller of his obligation to the department.

##### **(b) Reports.**

- (1) Any person completing or abandoning any well shall submit to the Division a record of the construction or abandonment. For public water supply wells, a copy of each completion or abandonment record shall also be submitted to the Health Department responsible for the county in which the well is located. The record shall be on forms provided by the Division and shall include certification that construction or abandonment was completed as required by these Rules, the owner's name and address, well location, diameter, depth, yield, and any other information the Division may reasonably require.
- (2) The certified record of completion or abandonment shall be submitted within a period of thirty days after completion or abandonment.
- (3) The furnishing of records to any person or agency other than the Division shall not constitute compliance with the reporting requirement and shall not relieve the driller of his obligation to the Department.

*History Note: Authority G.S. 87-87; 87-88;*